OCCASIONAL PAPER No. 67 August 23, 1937

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

THE WORK OF THE SOUTHERN FOREST EXPERIMENT STATION AND ITS APPLICATION TO PRIVATE FOREST MANAGEMENT

by

W. E. Bond, Senior Forest Economist

The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the Station. In some cases these contributions were first presented as addresses to a limited group of people and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

THE WORK OF THE SOUTHERN FOREST EXPERIMENT STATION AND ITS APPLICATION TO PRIVATE FOREST MANAGEMENT [1]

By W. E. Bond, Senior Forest Economist,
Southern Forest Experiment Station.

It is not my purpose to report to you on all of the research work done at the Southern Forest Experiment Station. This would be impossible in the time allotted to me, and you would not be interested in all of it. If you are interested in a report of all of the work, I would refer you to our last annual report, which will be gladly sent to you upon request. I should like to grasp this opportunity, however, to report to a group of landowners who think enough of their timber to spend money in protecting it from fire, the results of our investigations as they apply to practical and profitable forest management.

First of all, for the benefit of some of you who may not know about the Southern Station, let me say that we have our headquarters at New Orleans but carry out most of our forestry investigations on eight experimental forests in various parts of our territory between Texas and the Atlantic Ocean. Two of these forests are in Arkansas, one at Crossett, and the other on the Ouachita National Forest; two more are in Mississippi; two are in Florida; one is in Louisiana; and one is in Texas.

Since the territory includes eight States and many different forest types, sites, and conditions, the investigations of the Southern Forest Experiment Station must cover practically the whole field of forestry and many allied fields. To give you a picture of the work of our Station, allow me to point out very briefly the different divisions of research and the work covered by each. There are four divisions, namely, Silvics, Forest Influences, Economics, and Forest Survey. In addition there are three other cooperating agencies of the Department of Agriculture, namely, the Bureau of Plant Industry, the Bureau of Entomology and Plant Quarantine, and the Bureau of Biological Survey.

The Division of Silvics is the oldest, and many people still think of the Station as including only this division. Investigations in this division include studies of seed; nursery practices; planting; fire damage, behavior, and control; naval stores; thinning; pruning; stand improvement; natural reproduction; methods of cutting merchantable stands; volume tables; growth and yield of different tree species; and fundamental studies of forest soils, the physiology of different tree species, and the interrelationships of trees and their environment. These various studies supply the basic data for practical forest management. They determine underlying causes, measure effects, and seek to determine or develop the best practices. Since such studies are usually made on relatively small sample plots, where every factor can be accurately determined, reliable data on costs and returns usually cannot be obtained.

---

[1] Address delivered at The Second Annual Meeting of Arkansas State Forestry Commission Cooperators at Little Rock, Ark., July 6, 1937.

The Division of Forest Influences is studying effective and practical methods of rehabilitating deteriorated watersheds, and of safeguarding watershed values through the practice of forestry. Studies are also made of the influence of forest and other plant cover on run-off, evaporation, and groundwater storage.

Investigations in the Division of Economics include studies of the financial aspects of private forestry, forest taxation, and land use. These studies apply the results of the Silvics investigations and, through studies of logging, milling, and applied forest management, determine economic practicability and possibilities of profits. They are made on relatively large areas, using commercially feasible practices, and results are therefore applicable to the management of entire forest properties.

The Forest Survey is making an inventory of the extent, location, and condition of forest lands; the quantity, kinds, quality, and availability of the timber now standing on these lands; the rate of drain through cutting, fire, insects, disease, and other causes; the current and probable future rate of timber growth and the productive capacity of the forest area; and the present and probable future need for forest products in the different parts of the country by all classes of consumers. It also includes an analysis of the relations of these findings to one another and to other economic factors, as a basis for the formulation of policies and principles of forest-land utilization. It involves both field inventories and the compilation of data from many sources. The results obtained do not apply to definite properties but to larger areas such as States or relatively large portions thereof and to the South as a whole.

The cooperating agencies are studying the relationships of fungus diseases, insects, and wild life to forests and forest products. Often problems arise which, although outside the field of forestry, may seriously affect forestry practices - as, for example, the relationship of pine bark beetles to selective cutting.

And now what has research found out that you as forest landowners can use here in Arkansas? Let us forget about Station divisions and consider only those investigations from the Southern Station which contribute results usable in practical forest management. Although we do not yet know all the refinements of management, I think that from results of our research work we are now in a position to recommend the practices desirable in sustained-yield management and give you approximate costs and returns.

To make this more concrete, I suggest that we consider these investigations as they would apply to a definite property of 50,000 acres made up chiefly of second-growth stands of loblolly and shortleaf pine cut over at various periods up to 25 years ago and with about 10 percent of the area in old-field stands of various ages from reproduction up to sawlog size. If this area has typical second-growth timber, it is understocked, and the cut should be held to less than the growth until the growing stock has been built up.

In placing a forest property under management, the first consideration is adequate fire protection. I am sure that State Forester Gillett can tell you more definitely than I what is "adequate" fire protection, but I should say that the area burned annually over a period of years should

average less than 1 percent of the total area. Our studies have shown that there is no place for fire in the loblolly and shortleaf pine type; that fire destroys reproduction and may do serious damage to mature trees under certain conditions. I believe that at present fire protection costs forest owners about 2¢ per acre, and that the State and Federal Governments match this amount.

The next task in placing a forest property under management is to determine approximately the amount of growing stock and the growth for the property as a whole, in order to arrive at the allowable cut under sustained-yield management. Often an estimate of the merchantable timber is already available but, if not, this can be determined by a line-plot survey, running a line through the center of each section and tallying the merchantable timber on 1/4-acre plots at 1/8-mile intervals. A crew of two men could cover a property of 50,000 acres in about 1 month. By adding a third man, measurements of growth of trees of various sizes could be determined. From these sample areas the amount of merchantable timber and the annual growth for the whole property can be determined within reasonable limits of error. Such a survey is inexpensive but is sufficiently accurate to arrive at the amount of cut that can be made without depleting the capital growing stock. Of course the growing stock and growth by sections or by forest types and conditions can not be determined by such a survey. When cutting is actually started on definite areas, then is the time to take a more intensive inventory of the cut and of the residual stand for those areas.

Our studies of applied forest management have convinced us that in our irregular, uneven-aged shortleaf-loblolly stands we should practice selective cutting, making light cuts at intervals of 5 to 10 years. Each cut should take no more than will be regrown before the next cut, and where possible some growth should be reserved and added to the growing stock if the stand is understocked. With a 10-year cutting cycle the cut on fairly good sites should seldom remove more than 45 percent of the stand, and with a 5-year cutting cycle not more than 25 percent should be removed. If economically feasible, lighter cuts of 35 and 20 percent, respectively, are preferable since they will enable the stands to build up more rapidly. If an inventory and growth study such as the one mentioned above is made, the actual allowable cut can be determined within reasonable limits of error.

Our logging studies have shown that the costs of selective logging with trucks, removing as low as 500 board feet per acre, are very little higher than when cuts as heavy as 3 or 4 M feet per acre are made. Costs of selective logging are actually lower than costs of clear-cutting, because the size of the average log is larger. This is also true of milling costs. The grades and values of lumber cut from larger trees are much higher than those cut from smaller trees. For example, the value per M feet for stumpage and profit, that is, the difference between the sale value of lumber and all costs of logging, milling, and selling, was found to be $1.43 for 12-inch trees, $4.73 for 16-inch trees, $8.00 for 20-inch trees, and $11.42 for 24-inch trees. Evidently selective logging should be practiced if greater profits and greater yields are desired over a long management period.

When cutting begins on a definite area, actual forest management begins, and the forest owner should devote much thought and effort in determining the allowable cut and most profitable outlets for the material removed. Cutting to rigid diameter limits has been tried out in the past

but with little success. It is essential that an experienced technician select and mark each tree to be cut. To check his marking it is desirable to tally by diameter-classes all trees marked and also all sawtimber trees left for further growth. We have found that a crew of three or four men can mark and tally all of the sawtimber on 40 to 80 acres per day at a cost of not more than 10¢ per M feet of cut. In marking it is desirable to remove those trees which will not make satisfactory growth in volume, quality, or value between the present and the next cut. This includes old, financially mature trees as well as all crooked, defective, and low-quality trees of merchantable size. Of course the total cut on the areas selected for cutting must not exceed the volume which will grow back before the next cut, and it should be definitely less than this amount in order to build up the growing stock. By carefully marking the poorer trees the growth is shifted to the better trees, and the quality and value of the future growth is increased. By cutting trees of all diameters instead of only the larger ones the relative number of larger trees is increased and the productivity of the site is better utilized in growing merchantable material. Larger trees of high quality are of much greater value when cut into lumber, and also logging and milling costs are reduced. Greater profits are therefore returned to the owners from such management.

On our forest of 50,000 acres we assumed that we had a considerable area in old-field stands of different ages. In south Arkansas there is now a market for pulpwood, and pine trees above 5 inches d.b.h. can be utilized for this purpose. It is usually unprofitable to thin old-field stands until they are merchantable for pulpwood. Our studies have shown that 5-inch trees hardly pay for the cutting and hauling and that 6-inch trees yield very little profit. In fact it takes twice as long to cut a cord from 5-inch trees as from 13-inch trees. In thinning, we have found that the largest trees in young stands are generally very rough and are poor potential sawtimber. so that it is advisable to cut them and leave the cleaner, smaller trees to grow. In order to maintain a high growth rate consistent with high quality, stands should be thinned before the crowns are very severely reduced through competition, occupying only the very tops of the stems. Too early or too severe thinning, however, will result in brushy low-quality timber. Thinning is advisable every 5 years if the best results are to be obtained, and should not be postponed under any circumstances for more than 10 years. We have found these thinnings to yield stumpage values of 50¢ to 75¢ per cord. The volume removed depends on the density and size of timber, but in many cases 10 cords per acre or more can be removed without overcutting. Before thinning, either the trees to be cut or the trees to be left (whichever is the less work) should be marked, but it is not necessary to tally either class of trees if the man doing the marking is an experienced technician. The cost of marking has been found to be about 2¢ or 3¢ per cord, but the benefit in leaving the most promising trees to grow into high-grade sawtimber very definitely justifies this expense.

On any large property we will also have second-growth stands which are not yet large enough for sawtimber. These areas bear many defective, crooked, and limby trees which will not increase in volume or value at a satisfactory rate; and some of these stands also need thinning. We have found that in typical understocked second-growth stands about 1 cord of pulpwood per acre can be removed in an improvement cutting. When there is a market for fuelwood or chemicalwood, a profitable cut of hardwood cordwood can also be made. The cost of marking, not including an inventory of the stand,

amounts to between 3¢ and 4¢ per cord, but the stands after this cut has been made are left in a much better condition to grow high-quality sawtimber.

Another profitable practice, as shown by our studies, is the cutting of pulpwood from tops of felled sawtimber trees, from trees injured in logging, and from young trees marked to be removed to improve the density and quality of the stand. Such an operation, which should immediately follow logging, not only yields an income with which to pay taxes and other costs, but at the same time it assures increased growth of better timber in the future and reduces logging slash and the danger of forest fires. Our studies have shown that a stumpage value of at least 50¢ per cord remains after all costs are deducted from the selling price.

To summarize, the results of our investigations show that the following practices can be recommended to lumbermen and other owners of second-growth stands of loblolly and shortleaf pine.

1. Fire control that will limit the average area burned annually to less than 1 percent of the total area protected.

2. Thinning for pulpwood in dense young stands of old-field and second-growth timber, reserving the best-formed trees, properly spaced as basic growing stock for future development into high-quality sawtimber.

3. Improvement cutting for pulpwood or cordwood in second-growth stands which are wholly or largely unmerchantable for sawlogs, involving the gradual removal from all merchantable diameter-classes of trees that will not develop into high-quality material.

4. Periodic selective cutting at short intervals (5 to 10 years) in sawtimber stands, with each cut removing less volume than will be replaced by growth before the next cut, thus continually increasing the growing stock until it is sufficient for maximum production. As far as the felling budget will permit, the cut should be limited to trees financially mature because of size, poor condition, or low capacity for growth, in order to shift growth from trees of poor form and vigor to better trees. Within the limits of economic feasibility, the larger and more vigorous good trees should be included in the reserve stand so that as much as possible of the productivity of the site can be devoted to the growth of sawtimber of high quality and value.

5. Integrated utilization to the greatest extent consistent with available markets, providing for the highest and most profitable use of each tree and all portions of each tree. Pulpwood and cordwood should generally be produced from tops of sawtimber trees and from trees below sawlog size, removed as thinnings and improvement cuttings, and not from the portions of trees suitable for sawlogs.

Furthermore, I should like to point out that the studies made at the Station are showing that the management of second-growth stands of loblolly and shortleaf pine and hardwoods is financially profitable. Such typical stands in southeastern Arkansas average per acre about 3,000 feet b. m. (International 1/4-inch scale) of pine sawtimber (14 inches and more d.b.h.) and 1,000 feet of rather poor-quality hardwoods (14 inches and more d.b.h.),

besides considerable young growth. Studies show that these stands under sustained-yield management will yield at present values an annual gross income of from $1.00 to $1.75 per acre, depending on the management, growth, and economic conditions. Pine in these stands is growing in volume at a rate of about 7 percent compounded annually. Average stands of 3,000 feet b.m. of pine per acre, therefore, will grow during a 10-year period into stands containing 5,900 feet per acre or will grow at the average rate for this period of 290 feet per acre per year. Since even these stands of 5,900 feet per acre are understocked, the cut should not take all of the growth but should be limited to less than the growth, for example, to about 2,000 feet, leaving 900 feet for addition to the growing stock. Even this periodic cut is equivalent to an annual yield of 200 feet b.m. (30 cubic feet) per acre. In this same second-growth timber, the yield of pulpwood in cubic feet which can be cut from tops, thinnings, or improvement cuttings, at the end of the 10-year period, equals about two-thirds of the cubic-foot volume of the sawtimber cut. In such a case, with an annual yield of 30 cubic feet of sawtimber per acre, the additional yield of pulpwood is 20 cubic feet of solid wood (or 0.27 cord of stacked wood with bark) per acre per year.

At present, pine sawtimber stumpage ranges in value from $3 to $9 per M feet b.m. (2¢ to 6¢ per cubic foot), depending on size, quality, and location. At an average value of $6 per M board feet, the annual yield of 200 feet has a stumpage value of $1.20. The pulpwood yield of 20 cubic feet per acre per year with a stumpage value of 1¢ per cubic foot (75¢ per standard cord of 128 cubic feet) has a value of 20¢. The value of the annual yield of hardwoods is estimated at 15¢ per acre. Under these conditions, the gross income from total stumpage is $1.55 per acre per year. The total present cost of forest management including taxes, fire protection, technical services of a forester and assistants, general administration, etc., is estimated at 20¢ to 30¢ per acre per year.

After several cutting cycles under good management, these second-growth stands will be much better stocked with higher-quality trees, and yields will be correspondingly better both in volume and in quality. Measurements of volume growth in well-stocked second-growth stands indicate that the yield recorded above can be doubled when the stands are completely built up. It is estimated that costs, which may also increase (but not in the same proportion as income) may range from 30¢ to 50¢ per acre per year.

In conclusion I should like to invite you to visit any of the Station's experimental forests and, as lumbermen and forest owners in Arkansas, I extend to you a special invitation to inspect our work at Crossett. There you can examine the timber resulting from definite forest practices, and obtain the yields, incomes, and costs. There also you can inspect profitable sustained-yield forest management and integrated utilization as applied by large commercial operators.

I hope that I have made it clear that the results of our investigations are of practical use to those forest owners who wish to practice profitable sustained-yield forest management. We are gratified that an increasing number of owners of both large and small tracts of forest land are adopting the practices recommended, and we feel sure that as operators familiarize themselves with the principles of good forest management they will become progressively convinced of the fact that forest management pays.